Winchester Lake and Upper Lapwai Creek

Total Maximum Daily Load (TMDL)

prepared for

Winchester Lake Watershed Advisory Group

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1.0 EXECUTIVE SUMMARY

Background

Winchester Lake is located within the exterior boundaries of the Nez Perce Reservation as established by the 1863 Treaty with the Nez Perce. The lake sits approximately 30 miles southeast of Lewiston, Idaho, and one-half mile south of the town of Winchester in Lewis County. Winchester Lake is a manmade reservoir, created by the damming of Lapwai Creek in 1910, and is the focal point of 318-acre Winchester Lake State Park. The reservoir and its watershed lie entirely within the Nez Perce Reservation. The lake has a surface area of 100 acres, drains a watershed of 7,800 acres, and acts as a settling basin for the watershed.

Land coverage includes approximately 3,419 acres of forest and rangeland, 3,295 acres of dryland crops, and 697 acres of pasture. Land uses in the Winchester Lake watershed consist of dryland farming, grazing, timber harvesting and recreation.

Winchester Lake currently hosts populations of rainbow trout, largemouth bass, black crappie, black bullhead, yellow perch and tiger muskie. All these populations have been introduced to the lake and all are self-reproducing except tiger muskie, which are sterile. Naturally produced rainbow trout have been documented in recent years (1993-1996) in Winchester Lake and have probably occurred throughout the history of the lake.

Upper Lapwai Creek is the largest tributary to the lake, contributing about 70% of the average annual flow. The creek drains an area of 5,950 acres and has a stream length, including all tributaries, of approximately 27 miles. Fish species in the drainage include native redband and planted rainbow trout, sculpin, largemouth bass, and black bullhead.

Water Quality Problems

Citizen complaints of poor water clarity, odors and decline in angler success have led to several water quality studies at Winchester Lake since the mid-1980's. Blue-green algal blooms develop frequently, and periodic fish kills have occurred. All studies indicate Winchester Lake is severely eutrophic. A 1990 U.S. EPA Clean Lakes Program study identified the lake water quality problems as frequent nuisance algal blooms, poor water clarity, inadequate dissolved oxygen for fish, and concern over the potential for bacterial contamination.

Excessive sediment loading, degraded habitat and elevated temperatures are also having an adverse effect on redband trout and other native fish populations in Upper Lapwai Creek. Monitoring indicates that fine material is accumulating in pools and is clogging gravels which could be used for spawning. Low fish densities are believed to be a result of these impacts. Elevated concentrations of phosphorus and nitrogen compounds are also contributing to algae growth in certain areas of the creek, and Lapwai Creek is a major source of nutrients to the lake.

Actions to Date

The 1990 Clean Lakes Program Phase I study developed a lake restoration plan to address nutrient related problems. The restoration plan identified specific management activities for the watershed with the goal of reducing sediment and nutrient loading to the lake. A range of goals was provided because there was some uncertainty regarding the amount of phosphorous load reductions that will result from the combination of recommended watershed management and lake restoration techniques.

The Winchester Lake Phase II Implementation and Restoration Project began in June 1990 and concluded in 1995. Best Management Practices have been implemented throughout the watershed by private landowners, the Nez Perce Tribe, and the Idaho Department of Parks and Recreation with assistance from the Lewis Soil Conservation District, Natural Resources Conservation Service, and the State of Idaho.

Beneficial Uses Affected

Water quality problems in Winchester Lake and Upper Lapwai Creek are primarily impacting aquatic life such as cold and warm water fish species. Elevated bacteria levels in Upper Lapwai Creek are also impairing recreational uses. Designated beneficial uses for Winchester Lake include drinking water, agricultural water supply, cold water biota, primary and secondary contact recreation. Designated beneficial uses for Lapwai Creek include salmonid spawning drinking water, agricultural water supply, cold water biota, primary and secondary contact recreation. Since Winchester Lake is within a State Park, it is also designated as a special resource water.

Parameters of Concern

Parameters of concern listed in the Idaho 1994 §303(d) list for Winchester Lake are: nutrients, sediment, dissolved oxygen, temperature, flow, habitat alteration, pathogens, and pesticides. Upper Lapwai Creek is listed for six parameters: sediment, nutrients, temperature, pathogens, flow and habitat alteration. Pollutant sources in the Winchester Lake watershed include agriculture, silviculture, grazing, recreation, storm water, septic systems and the internal nutrient cycling from lake bottom sediments. These nutrients that cycle from lake bottom sediments originate from various sources within the watershed.

Total Maximum Daily Loads (TMDLs)

Total Maximum Daily Loads (TMDLs) are water quality management plans required under the Section 303(d) of the Clean Water Act for waters determined to not meet state water quality standards. The goal of a TMDL is to restore beneficial uses and achieve state water quality standards. Winchester Lake and Lapwai Creek were identified on Idaho's 1994 and 1996 303(d) lists as not meeting state water quality standards, and requiring TMDLs.

Since Winchester Lake and Lapwai Creek lie within the Nez Perce Reservation, a Memorandum of Agreement (MOA) was developed between the Nez Perce Tribe, the Environmental Protection Agency, and the State of Idaho Division of Environmental Quality to develop the TMDL, with the advice of the Winchester Lake Watershed Advisory Group. The MOA provides that all parties have agreed to use Idaho's Water Quality Standards in the TMDL development.

As additional information becomes available during implementation of the TMDL, the targets, loading capacity, and allocations may need to be changed. In the event that data show that changes are warranted, TMDL revisions will be made with the assistance of the Winchester Lake Advisory Group. Although specific targets and allocations are identified in the TMDL, the ultimate success of the TMDL is not whether these targets and allocations are met, but whether beneficial uses and state water quality standards are achieved and maintained.

The following discussion explains how all the listed parameters were addressed by the TMDL, and the attached table summarizes pollutant loading and allocations.

Phosphorus

Past water quality studies of Winchester Lake have indicated that excessive levels of nutrient compounds in lake waters and lake bottom sediment cause nuisance algae growth that causes depleted oxygen in the lake's deeper waters during the summertime/early fall. This oxygen depletion, combined with warm water in the lake's upper layers, greatly reduces the volume of water in the lake that supports a cold water fishery to less than 16% of the total lake volume. This TMDL estimates reductions in phosphorus loading to Winchester Lake needed to ensure that increased dissolved oxygen levels meet dissolved oxygen criteria, and that a sufficient volume of the lake meets both the dissolved oxygen and temperature criteria to fully support a cold water fishery.

The estimated total phosphorus load to the lake based on averaging past studies is 1926 lbs/year. The estimated necessary load reduction is 62% or 1187 lbs/year. This estimated reduction is based on two models that determine a load capacity based on desired in-lake phosphorus and dissolved oxygen levels. To achieve this reduction, a reduction of 741 lbs/year in the estimated phosphorus coming into the lake from Upper Lapwai Creek is allocated in the TMDL, which is 74% of the Creek's estimated phosphorus load of 1001 lbs/year. The rest of the estimated reduction (446 lbs) is proposed to be accomplished from in-lake management techniques that reduce the release of phosphorus from lake bottom sediments. To maximize the effectiveness of implementation, reductions from Upper Lapwai Creek should be achieved before in-lake management methods are applied. Nutrients are best controlled at the source before reaching the lake.

Nutrient reductions necessary to support beneficial uses in Upper Lapwai Creek are also evaluated in the TMDL. This evaluation determined that a 57% reduction in the total phosphorus loading to Upper Lapwai Creek would be needed during the algal growth season. This reduction is less than the 74% reduction estimated to be needed in Upper Lapwai Creek to meet the lake target. Thus, the reduction needed to meet the lake target is expected to resolve nutrient problems in Upper Lapwai Creek as well.

Sediment

Sediment is degrading the water quality of Upper Lapwai Creek and Winchester Lake. The sediment analysis indicates that major sediment reductions are needed to improve water quality and the fisheries of both the stream and the reservoir.

Fine sediments are inhibiting the native redband trout's ability to reproduce and flourish in Upper Lapwai Creek. The amount of fine sediment accumulating in the low gradient areas of the stream channel needs to be reduced. Overall, about a 90% reduction of the existing sediment load is needed to improve the fishery. Sediment entering Winchester Lake also needs to be reduced in order to reduce the amount of nutrients that they carry. These nutrients are one of the major causes of low dissolved oxygen levels in the reservoir.

Reducing erosion and sediment delivery through implementation of Best Management Practices will help improve water quality in Winchester Lake and Upper Lapwai Creek. The major sources of sediment are surface and stream bank erosion. Agricultural lands are likely the largest contributor of sediment, and both surface and bank erosion occur on these lands. The second major source of sediment is stream bank erosion on pasture lands.

Temperature

Winchester Lake

During the summer, the surface of the lake heats up considerably and adversely affects cold water species such as trout. Water cool enough for coldwater species ($<19^{o}$ C daily average) only occurs at a depth of 1.5 meters or greater within the lake. However, water below 2.5 meters has inadequate dissolved oxygen levels. As a result, only a narrow 1 meter layer of water exists during the summer which has adequate temperature and dissolved oxygen; 84% of the water column is uninhabitable by trout and other coldwater species.

The temperature analysis has concluded that temperature in the lake is elevated primarily because of the shallow nature, large surface area, and relatively low flow through the lake. Little can be done to change these conditions, or reduce the surface temperature of the lake. Therefore, the goal of the temperature TMDL is to increase dissolved oxygen in the deeper water by decreasing nutrient input, thereby allowing trout and other species to utilize the cooler water which meets the temperature criteria year-round. Additional detail on the effects of nutrients and control measures are included in sections regarding Phosphorus and Implementation Plans.

Upper Lapwai Creek

A temperature TMDL for Upper Lapwai Creek was established to address impaired salmonid spawning and rearing uses in the watershed. Solar radiation currently raises water temperatures in Lapwai Creek above the prescribed state water quality standards for salmonid spawning (9°C daily average) and coldwater biota (19°C daily average). Management activities within a watershed, such as removing riparian shade trees, harvesting of conifer overstory, grazing in riparian areas, and introducing bedload sediment which results in increased stream surface area, can increase the amount of solar radiation entering a stream.

The amount of heat energy (*i.e loading capacity*) which would meet state water quality temperature standards in the creek was determined by applying a modeling technique. Model results indicate that a 38% - 87% increase in shade is necessary in order to attain and maintain state water quality standards, depending on the stream reach. In addition to stream shade, other factors such as narrowing and deepening of the channel, colder water temperature from improved segments upstream, or increases in flow, may also help to decrease temperatures.

Bacteria

Fecal contamination from animal and human sources can cause illness in people swimming or fishing in lakes and streams. In the past, bacteria concentrations in Winchester Lake were quite high, likely due to improper sewage disposal. These problems are believed to have been corrected by the construction of a sewage lagoon for Winchester in 1972 which discharged to Lapwai Creek below Winchester Lake. Although recent data are not available, >98% of samples collected in 1988 were below the applicable standards.

Sampling in 1988 and 1993 indicates that fecal coliform levels exceeded state water quality standards at several locations within the Lapwai Creek drainage, but samples from other tributaries to the lake met the standards. Lapwai Creek is the most significant tributary to the lake, contributing 70% of the annual flow. Since Lapwai Creek is such a significant contributor to the lake, and since it appears that Winchester Lake meets bacteria standards, it was concluded that a bacteria TMDL for Upper Lapwai Creek would be adequately protective of both the creek and lake.

The sources of bacteria in Lapwai Creek are largely unknown, but it is suspected that cattle grazing in the watershed are a significant source. Improperly operating septic systems and other methods of sewage disposal may also be contributing at times.

Although data are extremely limited, it appears that a 90% reduction in bacteria concentrations at the mouth of Lapwai Creek would be needed to ensure that state water quality standards are met at all times.

Due to the age and limited nature of the bacteria data, a sampling effort is being planned for 1999 to reassess bacteria concentrations in Lapwai Creek and Winchester Lake. These data will be used to revise the bacteria load allocations set for Upper Lapwai Creek.

Pesticides

In 1985 low levels of DDT, hexachlorobenzene and hexachlorocyclohexane were found in trout and bullheads in Winchester Lake, prompting the listing of pesticides on the 1994 303(d) list for Winchester Lake. The primary concern was that there may be a health threat to individuals who regularly consume fish from the lake over a long period of time. To better establish whether pesticides in fish posed a problem, the USEPA, IDEQ and IDFG collected five fish species (trout, bullheads, perch, muskie, and largemouth bass) in April 1998 from five locations within the lake, and analyzed tissue samples for pesticides.

DDT compounds, hexachlorobenzene, triallate, and DDMU were detected in tissues samples, with the highest concentrations in bullheads. Analysis of these data indicates that the risk of health effects from eating these fish is very low, and does not exceed risk levels used to establish state water quality standards. As a result, a TMDL for pesticides has not been developed, and it is planned to remove pesticides from the 303(d) list for Winchester Lake.

Flow and Habitat

Flow and habitat are identified in the 1994 303(d)list as impairing uses in Winchester Lake and Upper Lapwai Creek This TMDL does not address flow and habitat issues because it is unclear whether these parameters are required to be addressed under Section 303(d) of the Clean Water Act. If EPA determines that TMDLs are required for water quality problems caused by flow and habitat modification, TMDLs will be developed.

Implementation Plan

The next step after completing the TMDL is to develop an implementation plan which spells out the actions needed on the ground to meet the goals of the TMDL. Implementation of Best Management Practices within the watershed will be on a voluntary basis.

A restoration plan to reduce excessive nutrients in Winchester Lake was developed as part of the Clean Lakes Study. The plan recommended a combination of agricultural, forestry, riparian, and direct runoff Best Management Practices; sedimentation basins and gully plugs; community education; and in-lake management techniques. These suggestions can be a starting point for developing an implementation plan for phosphorus for this TMDL.
Suggested agricultural Best Management Practices included conservation tillage, divided slope, stripcropping, grassed waterways, livestock stream crossings, fencing , small sedimentation basins and improved fertilizer management. Riparian Best Management Practices suggested to stabilize banks included terracing, fencing, livestock access ramps, log drop structures,

development of alternative livestock water sources, and vegetative plantings. Techniques for reducing erosion will also reduce phosphorus loading since the majority of phosphorus is associated with sediment. However, further study will be necessary as part of the implementation plan to identify the source of and best methods to reduce dissolved phosphorus.

The Clean Lakes Study recommended aluminum sulfate treatment as an in-lake management technique. Other options considered include hypolimnetic aeration, phosphorus inactivation through chemical treatment of surface in-flows, dredging, and full lake aeration. As part of this phased TMDL, the necessity of in-lake management techniques can be evaluated once the effectiveness of external source reductions has been determined.

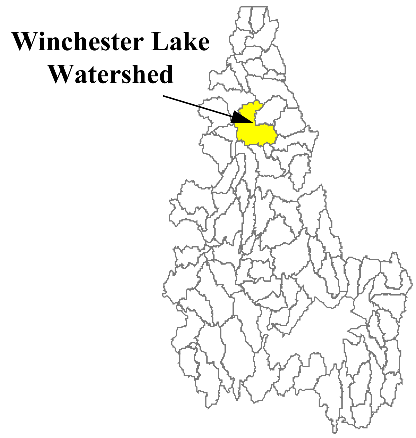
Implementation measures to address temperature concerns in Upper Lapwai Creek will likely be similar to measures needed to control sediment and phosphorus and include the following: 1) increasing riparian vegetative shade in various sub-watersheds, 2) reducing sediment input into Upper Lapwai Creek, 3) restoration of headwater reaches.

Techniques to reduce bacteria levels in Upper Lapwai Creek and its tributaries are less clear until the sources are further identified. In other Idaho watersheds with grazing activity, measures to control runoff from these operations has been a common practice to reduce bacteria levels.

Winchester Lake and Upper Lapwai Creek Loading and Allocation Summary

Pollutant	Waterbody	Target (s)	Subwatershed	Load	Load allocation	Reduction needed
Nutrients/DO	Winchester L.	37 ug/l total phosphorus		1926 lb/yr	739 lb/yr	62%
	Lapwai Cr.	50 ug/l total phosphorus (May thru Oct.)		42 lbs/month	18 lbs/month	57%
Sediment	Winchester L.	total reductions in sediment to Winchester Lake are the same as cumulative reduction in Upper Lapwai tributaries (LP6)		571 tons/yr	43 ton/yr	93%
	Lapwai Cr.	Improving trend in average annual sediment load with natural background as interim target and full support of salmonid spawning and cold water biota uses as the ultimate measure of success.	LP-1	322 tons/yr	21 tons/yr	93%
			LP-2	122 tons/yr	13 tons/yr	89%
			LP-3	234 tons/yr	18 tons/yr	92%
			LP-4	526 tons/yr	36 tons/yr	93%
			LP-5	555 tons/yr	40 tons/yr	93%
			LP-6	571 tons/yr	43 tons/yr	93%
Pathogens	Winchester L.	TMDL determined to be unnecessary				
	Lapwai Cr.	< 500 cfu/100 ml - at all times > 200 cfu/100 ml - <10% of samples over 30 days < 50 cfu/100 ml - geo. mean in 5 samples over 30 days		1.9E10 cfu/day @ 0.37 cfs	1.8E09 cfu/day @ 0.37 cfs	90%
Temperature	Winchester L.	Phosphorus/dissolved oxygen TMDL established as a surrogate for the temperature TMDL				
	Lapwai Cr.			**(j/m2/sec)**	**(j/m2/sec)**	**Shade increase needed**
		78% shade	LP-1	225.6	68.9	50%
		92% shade	LP-2	297.6	25.1	87%
		79% shade	LP-3	3.3.9	65.8	76%
		78% shade	LP-4	283.1	68.9	54%
		79% shade	LP-5	244.4	65.8	57%
		95% shade	LP-6	134.7	15.7	38%
Pesticides	Winchester L.	TMDL determined to be unnecessary				
Flow	Winchester L.	TMDL not developed until it is determined that TMDL's are required for impairments due to flow alteration				
	Lapwai Cr.	" "				
Habitat	Winchester L.	TMDL not developed until it is determined that TMDL's are required for impairments due to habitat alteration				
	Lapwai Cr.	" "				

2.0 WATERSHED ASSESSMENT



TMDL AT A GLANCE

Sub-basin(s):	Lower Clearwater
Uses affected:	Coldwater biota, salmonid spawning and rearing, secondary and primary contact recreation
Water quality concerns:	Nutrients, sediment, dissolved oxygen, temperature,
pathogens,	pesticides
Sources considered:	Nonpoint sources - agriculture, livestock grazing, timber harvesting

2.1 WATERSHED CHARACTERIZATION

General Description

Winchester Lake is located within the exterior boundaries of the Nez Perce Reservation as established by the 1863 Treaty with the Nez Perce. The lake sits approximately 30 miles southeast of Lewiston, Idaho, and one-half mile south of the town of Winchester in Lewis County. It is the focal point of 318 acre-Winchester Lake State Park and is surrounded by conifer forest. In 1910, the headwaters of Lapwai Creek were dammed to produce Winchester Lake. Tributary creeks above the lake are Big Springs, Scoles and Johnson Creeks (Moeller,1986). The lake was formed to serve as a mill pond, but by 1963 most of the marketable large-diameter timber in the area was harvested and the lake ceased to be used as a mill pond. The Idaho Department of Fish and Game purchased Winchester Lake from Potlatch Forests Inc. in 1966. In 1969, the Idaho Department of Parks and Recreation assumed management of the land surrounding the lake and developed Winchester Lake State Park (Moeller,1986). The City of Winchester, located on the north shore of the lake, discharged its municipal wastes via septic systems until the new wastewater facility became operational in 1972. Wastewater from the City of Winchester is now discharges downstream from the Winchester Lake outlet.

Winchester Lake has a surface area of 100 acres and receives surface runoff and groundwater supply from a tributary watershed drainage area of 7,800 acres and approximately one-third of the storm water runoff from the city of Winchester. The lake serves as a settling basin for the watershed. Lands are covered by: approximately 3,419 acres of forest and rangeland; 3,295 acres of dryland crops; and 697 acres of pasture.

Climate

Climatic data collected near Winchester Lake has recorded monthly precipitation from 1964 to present. Typically, summers are mild with air temperatures ranging from 80 to 95 Fahrenheit. Winters can be extremely cold with air temperature averaging about -15 Fahrenheit.

Summary of climate since 1964:

- average annual temperature: 42 Fahrenheit
- maximum summer temperature: 98
- minimum winter temperature: -40
- minimum January temperature: -26
- average annual precipitation: 24.76 inches
- maximum annual precipitation: 38.29 (1975)
- minimum annual precipitation: 17.90(1992)
- average winter snowfall: 94 inches
- intensity (2-year 24-hour rainfall): 1.5 inches

The majority of precipitation falls as rain during March, April, and May (Figure 1). During November, December, and January snow is the dominate form of precipitation. Monthly snow water equivalent is less than spring rainfall. Maximum monthly precipitation and peak stream flows is illustrated in Figure 2.

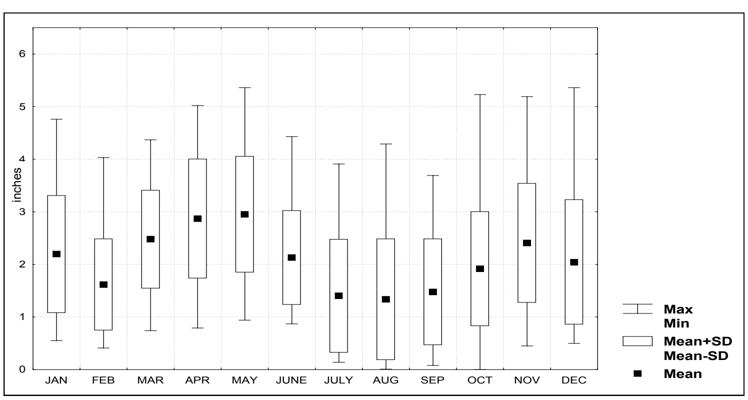


Figure 1. Duration Curve Illustrating Average, Maximum, and Minimum Precipitation by Month for the Period of Record (1995-1997)

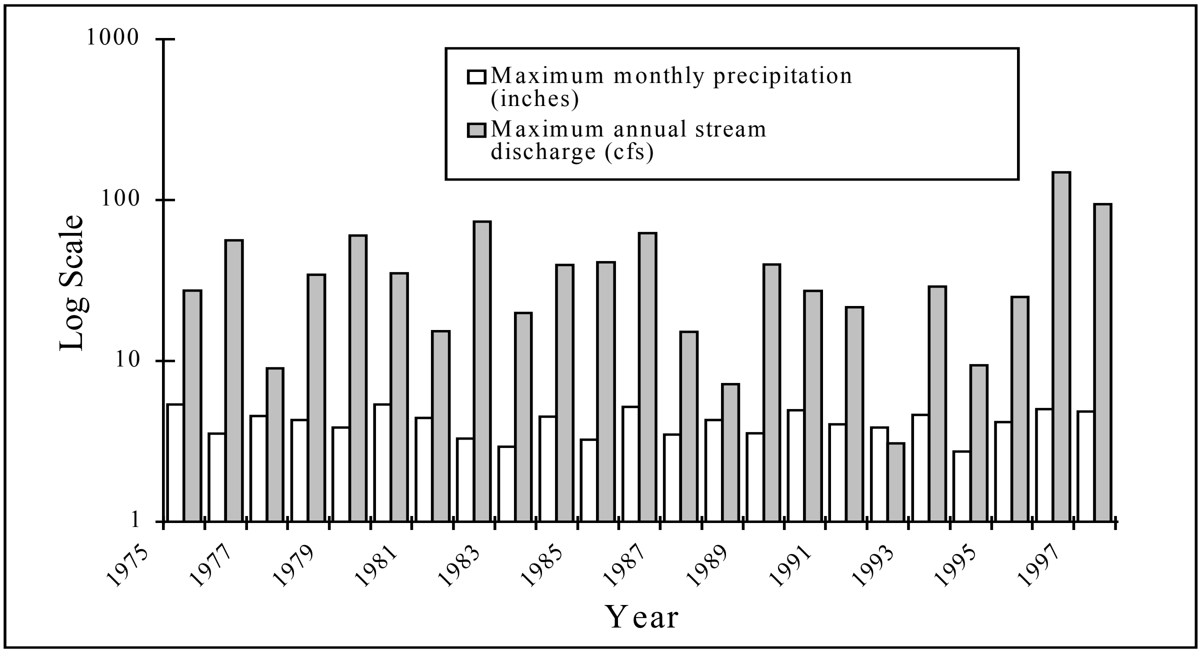


Figure 2. Winchester Lake Watershed Maximum Monthly Precipitation (1975-1997) and Annual Maximum Stream Discharge

Hydrology

Limited stream flow data exist for streams which drain into Winchester Lake. Latham (1986) measured Upper Lapwai Creek stream discharge 7 times during the 1985 water year. Entranco (1990) established a temporary stream gage on Upper Lapwai Creek and collected continuous stream stage from May 1988 to April 1989. Stream discharge was measured sixteen times and obtained high and low flow readings from 0.03 to 45.3 cfs. A smaller range of 0.08 to 20.2 cfs were measured by Wertz (1996) from October 1993 to May 1995.

According to Entranco (1990), the major source of inflow to Winchester Lake during 1988 and 1989 was surface runoff at 2,682 acre feet (79% of total). Total inflow to the reservoir, which includes stream inflow, groundwater inflow, precipitation, and direct runoff was 3,396 acre-feet. Total stream outflow in 1988 was 2,440 acre-feet (Associated Engineering Services, Inc., 1989). Total annual precipitation for these years was slightly above average (about 28 inches). Total annual precipitation when Wertz measured stream flow, was slightly below normal (Wertz, 1996).

A hydrograph was predicted for Upper Lapwai Creek to extend the flow record, characterize the extreme low and high flow regimes, and help validate flow estimates predicted using other models. The periodic stream flow data sets discussed above were regressed against data from a USGS stream gage, and a synthetic hydrograph was predicted for water years 1975 through 1997. For the details of this analysis refer to Appendix A.

This TMDL is concerned with two aspects of the hydrograph. First, the magnitude and frequency of flood events are important when trying to understand pollutant loading to the reservoir. Second, the magnitude and frequency of low flow events are needed to characterize the loading capacity of streams which drain to the reservoir.

Using the predicted hydrograph, the mean annual flood event or bankfull discharge is about 31 cfs. This flood event is defined as the channel maintaining flow and is used in the temperature TMDL to characterize average annual loading to the reservoir. The flood of record occurred in 1996 with a magnitude of about 150 cfs. This type of flooding is typically caused by either rain-on-snow or rain-on-frozen soil precipitation events. The 1996 flood was a result of a rain-on-snow event. Annual snow melt also generates higher flows, however, these events are small in comparison to rain-on-snow events. This point is illustrated in the data where the magnitude of annual peak stream flows do not correlate well with annual or monthly maximum precipitation (Figure 2).

Using the predicted hydrograph data, the minimum seven-day stream flow with a ten-year recurrence interval (7Q10) is about 0.48 cfs. For the temperature TMDL, this flow event is used to characterize the maximum amount of a pollutant a stream can assimilate and still meet state water quality standards. Low flows typically occur toward the latter part of the summer and continue through to at least November.

Winchester Lake and Upper Lapwai Creek were subdivided into fourteen subwatersheds (Figure 3 and Table 1). Upper Lapwai Creek is the largest watershed (9.3 mi^2) and contains six subwatersheds. Three smaller watersheds drain into Winchester Lake and range in size from 1.3 to 0.4 mi^2. Additionally, there are three face drainages which are less than 0.4 mi^2. Subwatershed drainage density is about 3 miles of stream per square mile.

The dominant aspect of the watershed is north; however, subwatershed aspect ranges from north-east to north-west (Table 1). The watershed is slightly dissected with a dendritic drainage texture. Elevation ranges from about 3900 feet (1189 meters) at Winchester Lake to 4639 feet (1414 meters) at Mason Butte. Physical and hydrological characteristics of the Winchester Lake subwatersheds are summarized in Table 1.

Lake Morphometry

The shape and depth of a lake basin greatly influence the response of a lake to pollutants entering the lake, particularly nutrients. Shallow lakes are more susceptible to eutrophication as a result of nutrient loading than deeper lakes. The ratio of watershed area to Winchester Lake surface area is large (88:1). Winchester Lake is a small, shallow lake with a flushing rate of 1.95 per year (Entranco, 1990). Physical and hydrological characteristics of Winchester Lake are summarized in Table 2.

Table 1. Summary of Winchester Lake subwatershed characteristics.

Subwatershed Code	Area (mi^2)	Stream Density (mi/mi^2)	Maximum Elevation (ft)	Minimum Elevation (ft)	Bankfull Discharge	Watershed Aspect
LP	9.3	2.9	4603	3902	31.0	NW
LP-1	2.8	3.3	4492	4008	9.4	N
LP-2	1.3	2.6	4603	3993	4.2	NW
LP-3	1.3	2.8	4390	3993	4.5	N
LP-4	2.0	2.5	4403	3997	6.7	NE
LP-5	1.3	3.2	4265	3902	4.2	NW
LP-6	0.6	2.3	4305	3902	1.9	NE
WW-1	1.3	2.1	4383	3910	4.4	NE
WW-2	0.4	1.9	4242	3918	1.4	E
WW-3	0.4	2.4	4167	3902	1.4	W
FD-1	0.1	0.2	4026	3902	0.4	S
FD-2	0.1	0	4026	3902	0.4	
FD-3	0.2	1.2	4059	3902	0.6	N
FD-4	0.04	0	4059	3902	0.2	
FD-5	0.1	0.9	4059	3902	0.2	

Table 2. Physical and Hydrological Characteristics of Winchester Lake (after Entranco,1990 with Update Based on IDL Mapping Effort)

Lake Surface Area	100 acres
Maximum Depth	35 ft
Mean Depth*	23 ft
Lake Volume	1,960 acre-ft
Drainage Basin Area	7,800 acres
Surface Lake Elevation	3,902 ft
Flushing Rate	1.95 $year^{-1}$

*Moeller, 1985

Geology

Bedrock geology consists primarily of basalt in the southern and western portions of the Winchester Lake watershed and granitic rocks in the northern and eastern portions (Figure 4). Overburden geology consists of basalt and granitic colluvium blanketed by loess, particularly in the immediate vicinity of the lake. A northwest-trending dip-slip fault has been mapped in the southeastern portion of the watershed.

Topography/Soils

Elevation of the Winchester Lake watershed ranges from 4,639 ft at Mason Butte to 3,902 ft at the lake surface. The slopes vary from 1% to 50% on forest land, and 1% to 20% on cropland. Soils in the watershed are primarily of forest origin (Boles-Joel complex, Johnson-Kruse complex and Johnson-Labuck complex) and can be classified as well-drained sandy to silt loams. The latter 2 soil types are classified as highly erodible. They are prone to erosion if left unvegetated by conventional tillage practices. Soils commonly associated with riparian areas are generally poorly-drained with a seasonally high water table, but not highly erodible. Soils distribution for the watershed is shown in Figure 5.

Fisheries

Winchester Lake was acquired in 1964 by Idaho Department of Fish and Game to provide sport fishing opportunity to the public. The lake was subsequently drained and cleaned of logs and debris remaining from its' operation as a mill pond. Since then, Winchester Lake has been host to many species of fish and has been chemically rehabilitated at least once to remove undesirable species.

Winchester Lake currently hosts populations of rainbow trout, largemouth bass, black crappie, black bullhead, yellow perch and tiger muskie. All these populations have been introduced to the lake and all are self-reproducing except tiger muskie, which are sterile. Naturally produced rainbow trout have been documented in recent years (1993-1996) in Winchester Lake and have probably occurred throughout the recent history of the lake. Fish species in Upper Lapwai Creek include native redband and planted rainbow trout, sculpin, largemouth bass, and black bullhead.

The majority of anglers at Winchester Lake fish for trout. The other species in the lake have either been illegally introduced or planted to diversify the fishery or control other species. For example black bullheads were illegally introduced to Winchester Lake. Bullheads quickly became well established, very numerous and relatively small. Bullhead numbers are currently controlled by predation from introduced largemouth bass. Winchester Lake now produces the largest black bullheads in the region because their numbers are relatively low.

According to Wertz (1996), Winchester Lake is the most intensively fished lake in North Central Idaho. An Idaho Department of Fish and Game study estimated that anglers spent over 43,000 hours fishing in Winchester Lake from January 15 to October 15, 1993. This represents approximately 430 hours of effort per acre annually, compared to Dworshak Reservoir that receives, on average, approximately 15 hours of effort per acre annually. Natural production of trout in Winchester Lake cannot provide for this level of use. To satisfy angler demand and meet IDFG fishery management objectives of 0.75 fish per hour in Winchester Lake, a stocking program is necessary. From 1990 to 1995 IDFG stocked an average of 46,538 fingerling and 30,594 catchable size trout per year. Current stocking level is 30,000 fingerling and 45,000 catchable size trout annually.

Trout are opportunistic feeders; their preferred food in Winchester Lake is zooplankton. During 1991-1993 IDFG studies showed 3-inch fingerling rainbow stocked in late May grew well through the summer and started contributing to the fishery in September as approximately 8-inch long fish. These fish continued to be caught throughout the ice fishery and into the spring months as 10- to 12-inch fish. Total estimated return was 10% numerically and 800% by weight. Estimated return of catchable size trout ranges from 60% to 80%.

Yellow perch were illegally introduced into Winchester Lake in 1993. The perch population may now exceed the trout population. Yellow perch will negatively affect the trout population by competing with trout for zooplankton, resulting in lower trout growth rates. Increased predation on zooplankton may also lead to larger phytoplankton blooms, due to decreased consumption by zooplankton which feed on phytoplankton.

The fact that the fishery in Winchester Lake has been relatively consistent over the past decades cannot be used as a relative judge of the water quality or environmental conditions in the lake. Favorable catch rates and successful trout fisheries are artificially created by stocking trout in Winchester Lake. Trout management in Winchester Lake exploits the productivity benefits of a eutrophic environment and gambles that the same eutrophic environment doesn't get pushed beyond the survival tolerances of trout.

Low dissolved oxygen levels in the hypolimnion during stratification periods and under ice cover can pose a significant problem for trout in Winchester Lake. Inadequate levels of dissolved oxygen has led to two fish kills, primarily trout, in Winchester Lake in winter 1992 and October 1994. The 1992 fish kill occurred when a thin layer of snow covered the ice. The 1994 fish kill occurred when the lake mixed. Several days before that mixing, IDFG had stocked the lake with 10,000 catchable trout.

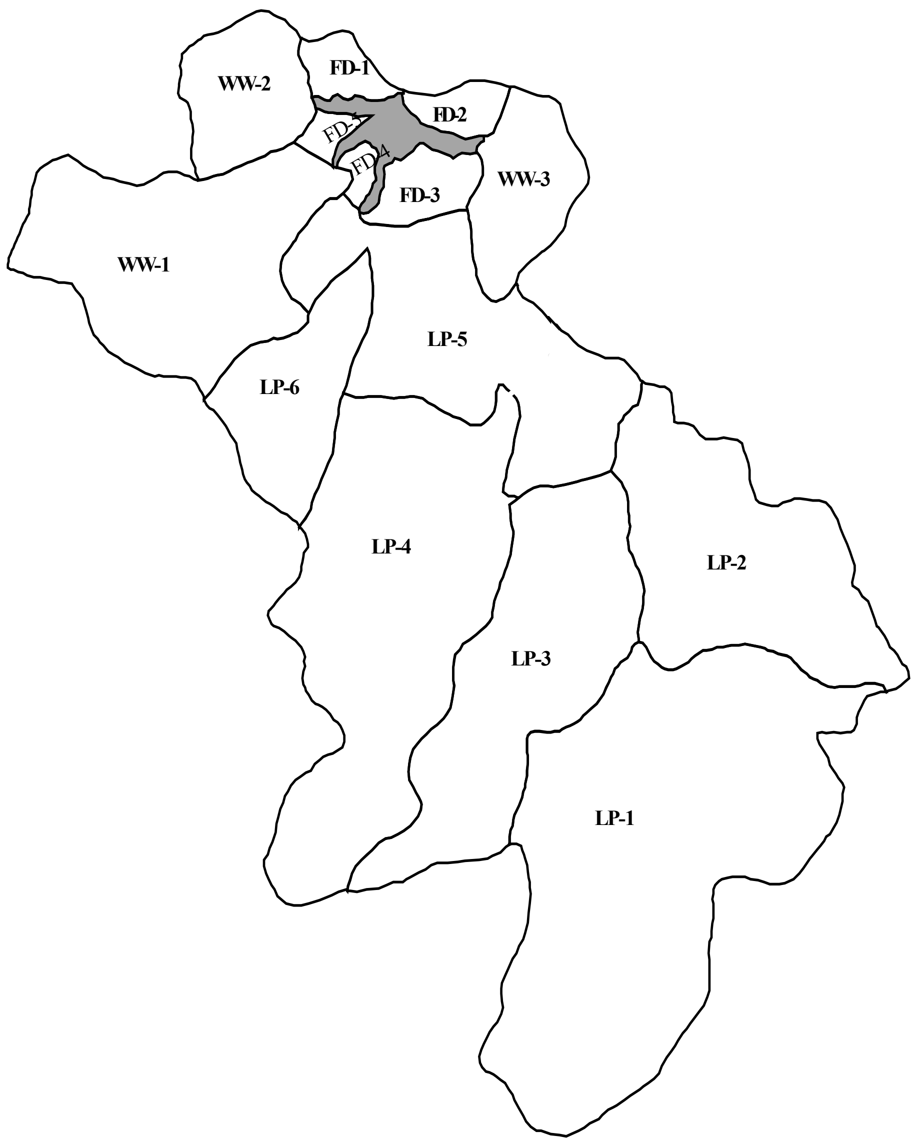


Figure 3. Winchester Lake Subwatershed Location Map

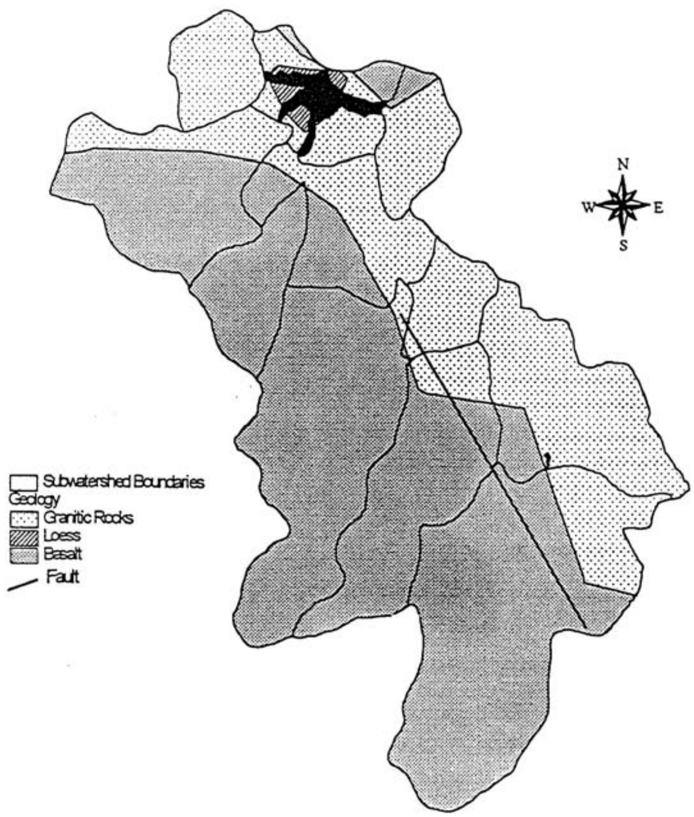


Figure 4. Winchester Lake Geology Map

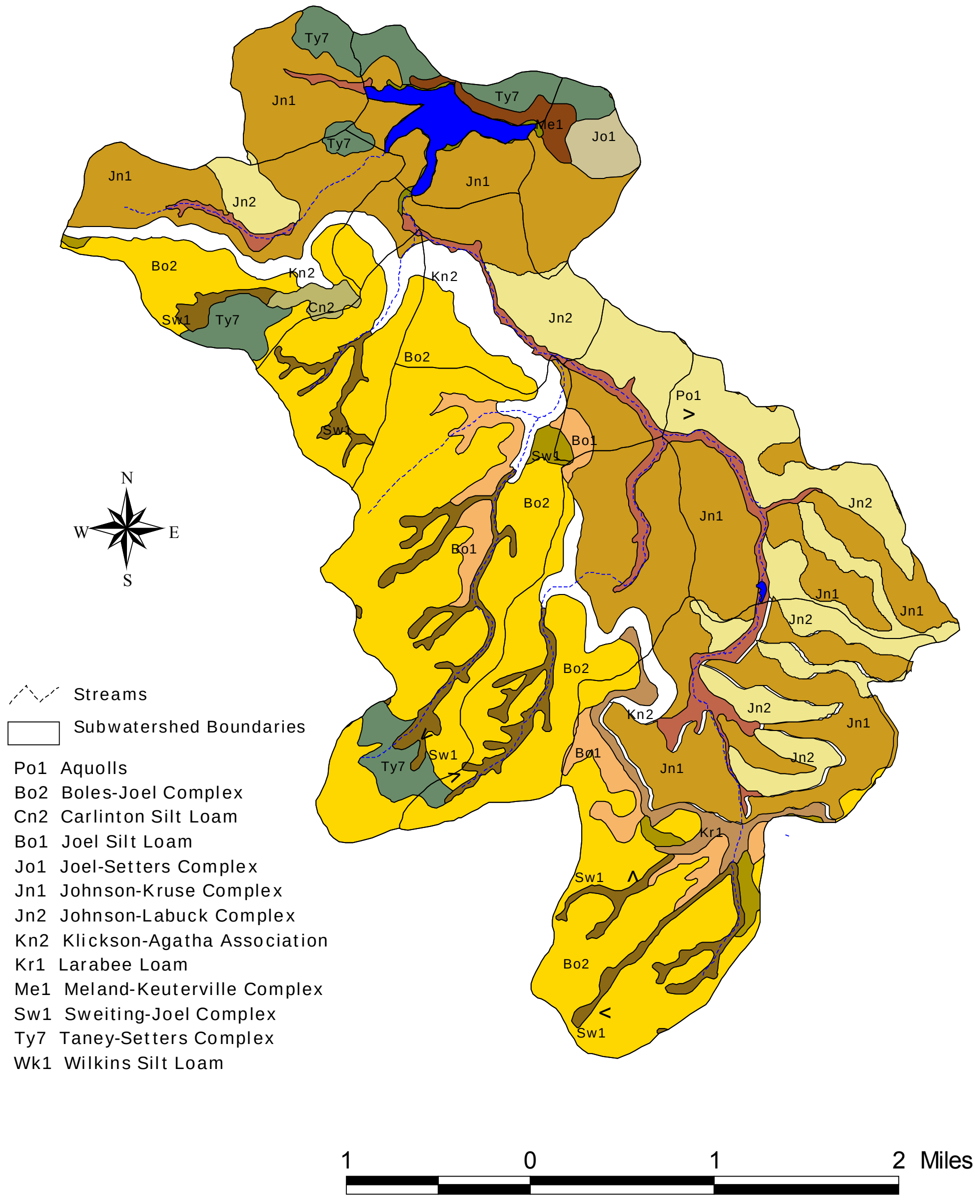


Figure 5. Winchester Lake Soils Distribution Map

Land Uses

Land uses in the Winchester Lake watershed are shown in Figure 6. Uses consist of: 1) cropland, 2) pastureland, 3) timber harvesting, 4) recreation. Land management, including past and present ranching, farming, and timber harvest, have converted range and forest land to agriculture causing patterned, persistent landscape disturbance. Fifty-two percent (3,992 acres) of the land in the watershed is comprised of crop and pastureland; 44% (about 3,419 acres) is used as forest and rangelands; and 2% (160 acres) is used for residential purposes (Table 3). Figure 7 shows land ownership in the Winchester Lake watershed. Five jurisdictions share the watershed: the State of Idaho Parks and Recreation, Idaho Fish and Game, Lewis County, the City of Winchester, and the Nez Perce Tribe.

The state park is open year-round for a variety of uses and has approximately 50,000 visitors per year. Boating (no gas motors), fishing, camping, picnicking and hiking are the primary summer activities. Ice fishing, ice skating and cross-country skiing are the main winter activities. The major park facilities are shown in Figure 8. Fishing is the major attraction at Winchester Lake (over 40,000 fishing hours per year). A wolf enclosure operated by the Wolf Education Research Center (WERC), under an agreement with the Nez Perce Tribe on tribal land, is expected to draw a significant number of visitors and subsequently increase visitation at Winchester Lake State Park.

2.2 WATER QUALITY CONCERNS AND STATUS

Federal Requirements for Water Quality Limited Waters

The Federal Clean Water Act (CWA) requires restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters (Public Law 92-500 Federal Water Pollution Control Act Amendments of 1972). Each state is required to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the water whenever attainable.

Section 303(d) of CWA establishes requirements for states to identify and prioritize waterbodies that are water quality limited (i.e. waterbodies that do not meet state water quality standards). Current regulations require states to publish a priority list of impaired waters every 2 years.

For waters identified on this list, states must develop Total Maximum Daily Loads (TMDLs) set at a level to achieve state water quality standards. TMDLs are defined in 40 CFR Part 130 as the sum of the individual Waste Load Allocations (WLA) for point sources and Load Allocations (LA) for nonpoint sources, including a margin of safety and natural background conditions. In essence, TMDLs are water quality management plans that allocate responsibility for pollution reduction with a goal of achieving state water quality standards within a specified period of time.

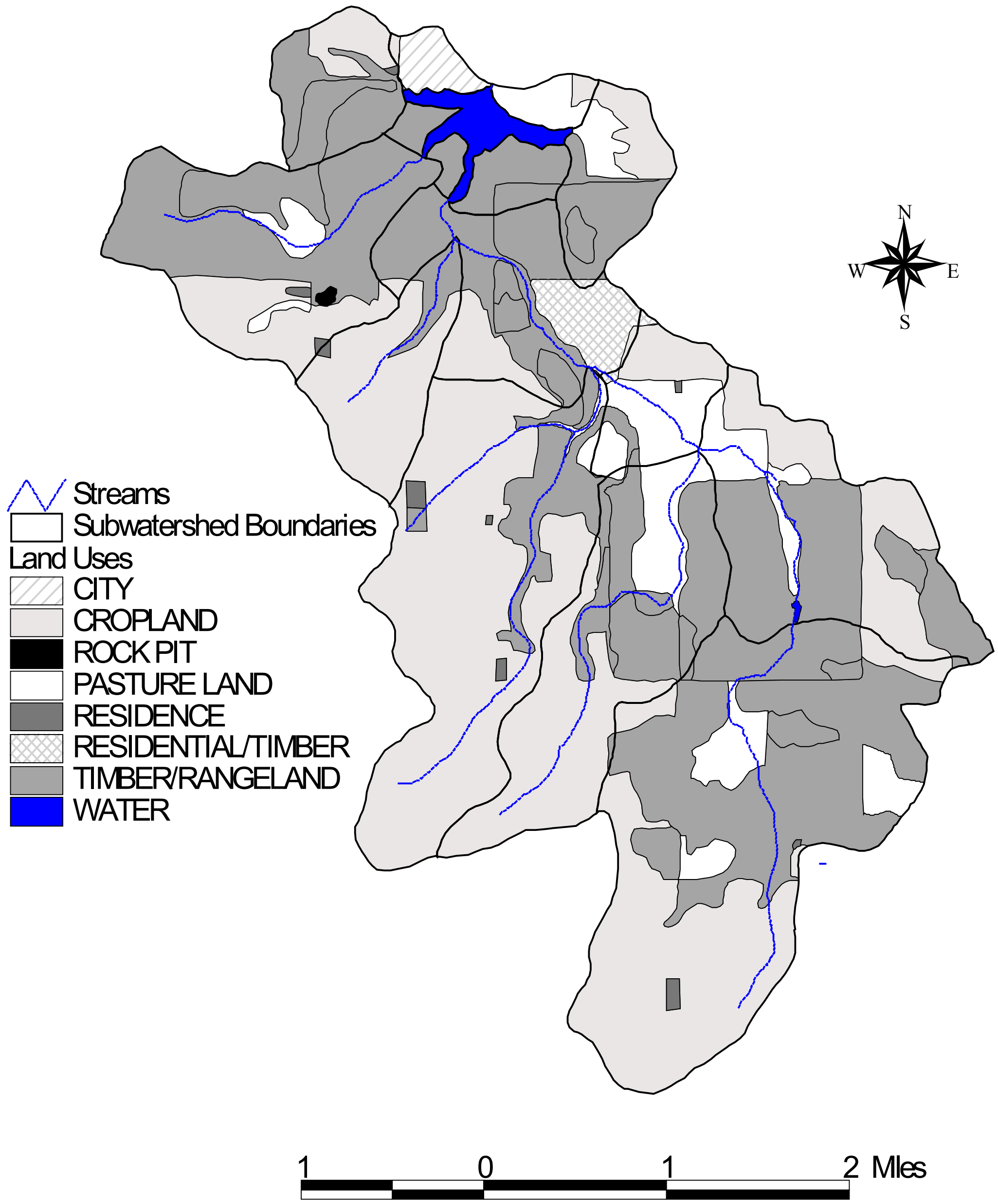


Figure 6. Winchester Lake Land Use Map

Table 3. Winchester Lake subwatershed land uses.

Land Uses	WW-1	WW-2	WW-3	LP-1	LP-2	LP-3	LP-4	LP-5	LP-6	FD-1	FD-2	FD-3	FD-4	FD-5	Total Acres
Cropland	204	72	76	710	264	396	1064	179	315	5	10				3295
Pastureland	52		46	156	103	121	20	139			60				697
Residential	6	2		8			14	2	2						34
Residential/ Timber			3					123							126
Rock Pit	5														5
Timber/ Rangeland	571	201	147	939	441	344	198	360	50			108	27	33	3419
Urban										70					70
Water					2										102*
Total Acres	**839**	**275**	**272**	**1813**	**810**	**861**	**1296**	**803**	**367**	**75**	**70**	**108**	**27**	**33**	**7748**

* This total includes 100 acre surface of Winchester Lake.

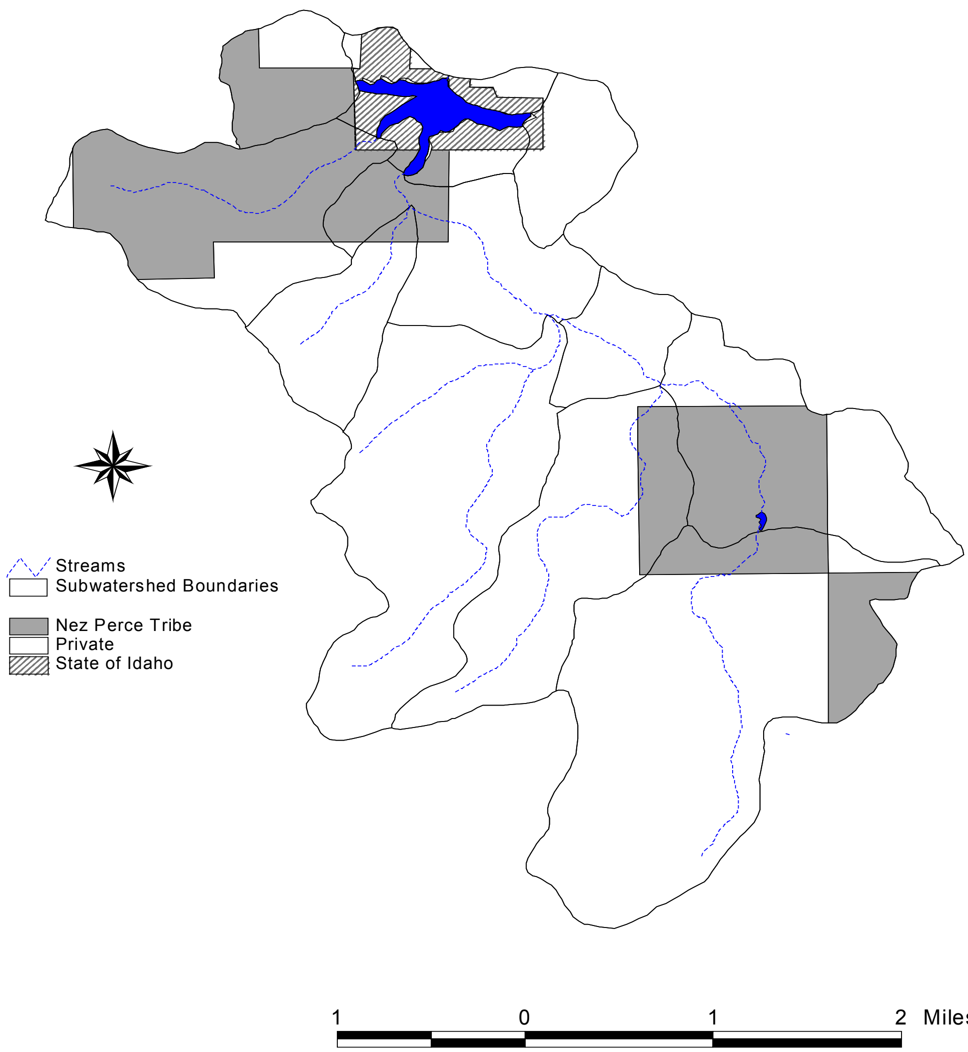


Figure 7. Winchester Lake Land Ownership Map

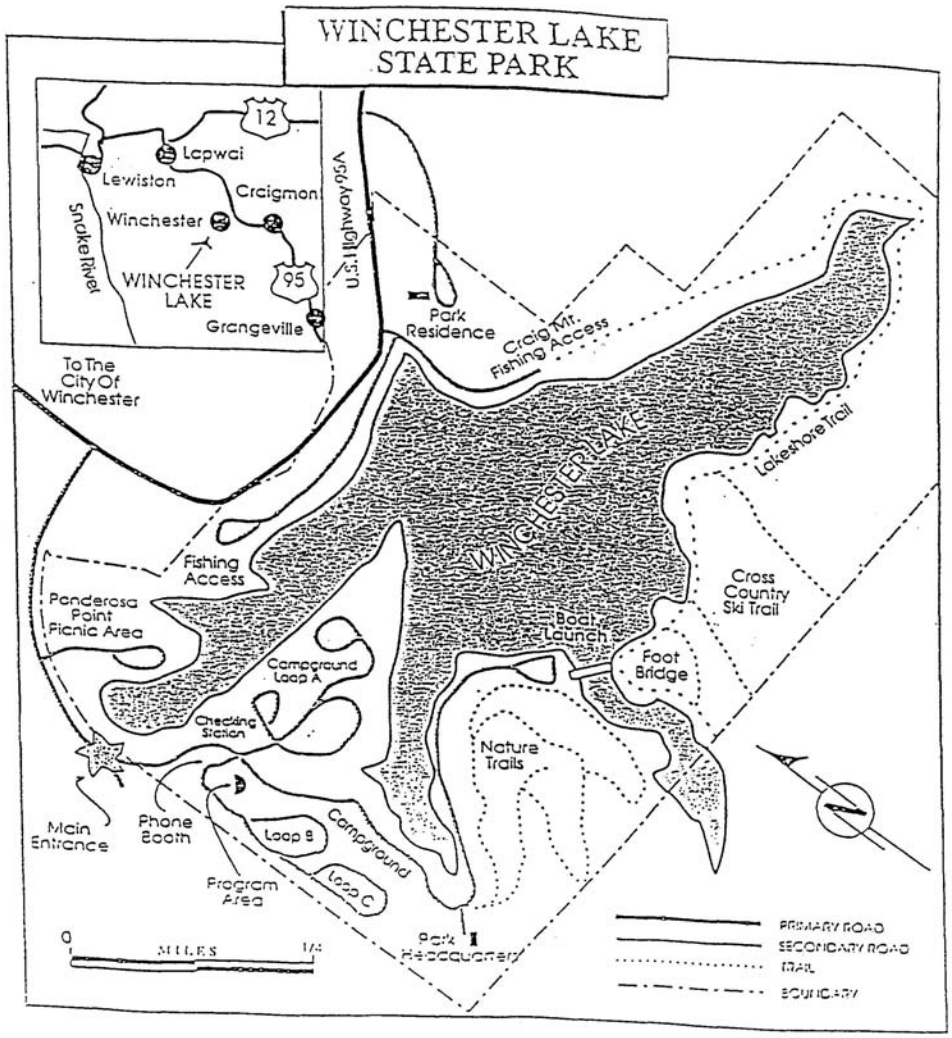


Figure 8. Winchester Lake State Park Facilities

Surface Water Beneficial Use Classification

Surface water beneficial use classifications are intended to protect the various uses of the state's surface water. Idaho waterbodies that have designated beneficial uses are listed in Idaho's Water Quality Standards and Wastewater Treatment Requirements (IDHW 1996). They are comprised of 5 categories: aquatic life; recreation; water supply; wildlife habitat; and aesthetics.

Aquatic life classifications are for waterbodies that are suitable or intended to be made suitable for protection and maintenance of viable communities of aquatic organisms and populations of significant aquatic species. Aquatic life uses include cold water biota, warm water biota, and salmonid spawning.

Recreation classifications are for waterbodies that are suitable or intended to be made suitable for primary contact recreation and secondary contact recreation. Primary contact recreation (swimming, wading, etc.) depicts prolonged and intimate contact by humans where ingestion is likely to occur. Secondary contact recreation (fishing, boating, etc.) depicts recreational uses where ingestion of raw water is not probable.

Water supply classifications are for waterbodies which are suitable or intended to be made suitable for agriculture, domestic, and industrial uses. Wildlife habitat waters are those which are suitable or intended to be made suitable for wildlife habitat. Aesthetics are applied to all waters.

Designated Beneficial Uses of Winchester Lake and Upper Lapwai Creek

Beneficial uses identified for Winchester Lake in the *Idaho Water Quality Standards and Wastewater Treatment Requirements* are: domestic water supply, agricultural water supply, cold water biota, primary and secondary contact recreation (IDAPA 16.01.02). Beneficial uses identified for Upper Lapwai Creek are: domestic water supply, agricultural water supply, cold water biota, salmonid spawning, primary and secondary contact recreation (IDAPA 16.01.02). Because it is in a state park, Winchester Lake is also designated as a special resource water.

Water Quality Criteria

Since Winchester Lake and Lapwai Creek lie within the Nez Perce Reservation, a Memorandum of Agreement (MOA) was developed between the Nez Perce Tribe, the Environmental Protection Agency, and the State of Idaho Division of Environmental Quality, stating that Idaho's Water Quality Standards will be used in developing the TMDL.

Idaho water quality standards include criteria necessary to protect designated beneficial uses. The standards are divided into 3 sections: General Surface Water Criteria, Surface Water Quality Criteria for Use Classifications, and Site-Specific Surface Water Quality Criteria (IDHW, 1996).

The following water quality criteria are applicable to pollutants of concern as listed on the 1994 303(d) list and uses designated for Winchester Lake and Upper Lapwai Creek.

IDAPA 16.01.02.200.01
Hazardous Materials. Surface waters of the state shall be free from hazardous materials in concentrations found to be of public health significance or to impair designated beneficial uses. These materials do not include suspended sediment produced as a result of nonpoint source activities.

IDAPA 16.01.02.200.02
Toxic substances. Surface waters of the state shall be free from toxic substances in concentrations that may impair designated beneficial uses. These substances do not include suspended sediment produced as a result of nonpoint source activities.

IDAPA 16.01.02.200.03
Deleterious materials. Surface waters of the state shall be free from deleterious materials in concentrations that may impair designated beneficial uses. These materials do not include suspended sediment produced as a result of nonpoint source activities.

IDAPA 16.01.02.200.05
Floating, Suspended, or Submerged Matter. Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities.

IDAPA 16.01.02.200.06
Excess Nutrients. Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses.

IDAPA 16.01.02.200.07
Oxygen-Demanding Materials. Surface waters of the state shall be free from oxygen demanding materials in concentrations that would result in an anaerobic water condition.

IDAPA 16.01.02.200.08
Sediment. Sediment shall not exceed quantities specified in Section 250, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in Subsection 350.02.b. Subsection 350.02.b generally describes the BMP feedback loop for nonpoint source activities.

IDAPA 16.01.01.250.01.a
Primary Contact Recreation: between May 1 and September 30 of each calendar year, waters designated for primary contact recreation are not to contain fecal coliform bacteria significant to the public health in concentrations exceeding:

i. 500/100ml at any time; and

ii. 200/100 ml in more than 10% of the total samples taken over a 30-day period; and

iii. A geometric mean of 50/100 ml based on a minimum of 5 samples taken over a 30-day period.

IDAPA 16.01.01.250.01.b
Secondary Contact Recreation: waters designated for secondary contact recreation are not to contain fecal coliform bacteria significant to the public health in concentrations exceeding:

i. 800/100 ml at any time; and

ii. 400/100 ml in more than 10% of the total samples taken over a 30-day period; and

iii. A geometric mean of 200/100 ml based on a minimum of 5 samples taken over a 30-day period.

IDAPA 16.01.01.250.02.a.iv
iv. All toxic substance criteria set forth in 40 CFR 131.36(b)(1), Columns B1, B2 and D2, revised as of December 22, 1992, effective February 5, 1993 (57 FR 608-48, December 22, 1992) provided, however, the standard for arsenic shall be fifty (50) ug/L for Column D2. 40 CFR 131.36(b)(1) is hereby incorporated by reference in the manner provided in subsection 250.07.

IDAPA 16.01.01.250.02.c
Cold Water Biota: water designated for cold water biota are to exhibit the following characteristics:

i. Dissolved Oxygen Concentrations exceeding 6 mg/l at all times. In lakes and reservoirs this standard does not apply to:

(1) The bottom twenty percent (20%) of water depth in natural lakes and reservoirs where depths are 35 m or less.

(2) The bottom seven (7) m of water depth in natural lakes and reservoirs where depths are greater than thirty-five (35) m.

(3) Those waters of the hypolimnion in stratified lakes and reservoirs.

ii. Water temperatures of 22 ^{o}C or less with a maximum daily average of no greater than 19 ^{o}C.

iv. Turbidity below any applicable mixing zone set by the Department, shall not exceed background turbidity by more than 50 NTU instantaneously or more than 25 NTU for more than ten (10) consecutive days.

IDAPA 16.01.01.250.02.d
Salmonid spawning: waters designated for salmonid spawning are to exhibit the following characteristics during the spawning period and incubation for the particularspecies inhabiting those water:

i. Dissolved Oxygen.

(1) Intergravel Dissolved Oxygen.

(a) One (1) day minimum of not less than five point zero (5.0) mg/l.

(b) Seven (7) day average mean of not less than six point zero (6.0) mg/l.

(2) Water-Column Dissolved Oxygen.

(a) One (1) day minimum of not less than six point zero (6.0) mg/l or ninety percent (90%) of saturation, whichever is greater.

ii. Water temperature of thirteen (13) degrees C or less with a maximum daily average no greater than nine (9) degrees C.

Past Water Quality Studies and Available Monitoring Data

Several evaluations of water quality conditions in the Winchester Lake watershed have been undertaken since the early 1980s. These studies document the eutrophic condition of the lake and the pollution impacts that come from the watershed.

1) <u>1972 IDHW Division of the Environment Study, Tulloch, 1972</u>. During August, Ed Tulloch and Mike McMasters conducted a limnological survey of Winchester Lake. A total of 6 stations were sampled on the lake for bacteriological and chemical analysis, dissolved oxygen and temperature. Secchi-disk transparency readings were determined as well as bottom depth soundings. Each station was also sampled with an Eckman dredge and a plankton net. Laboratory results for bacteriological quality indicated maximum concentrations to be located near the Winchester city side of the lake, probably due to domestic sewage discharge. The other

stations indicated lower coliform concentrations. Bottom dredge samples seemed to indicate bottom concentrations generally composed of bark and decaying wood along the eastern shore of the lake. The bottom samples of the western areas of the lake demonstrated no bark or decaying wood; mud, silt, and little aquatic life were present.

The August sampling showed that secchi-disk transparency ranged from 4 ft to 5.5 ft. Depth soundings at the several stations ranged from 13 ft to 32 ft. The dissolved oxygen, at a depth of 4 ft, ranged from 11.2 to 13.8 parts per million (ppm). Temperature, at a depth of 4 ft, ranged from 21.2 to 24°C. A dissolved oxygen and temperature reading were also noted on the bottom at stations 2 and 3, averaging 0.5 ppm and 13°C respectively.

2) Lapwai Creek Study, Idaho Department of Health and Welfare, 1980. A study done by IDHW-DEQ in 1979 indicated that water quality in Lapwai Creek was marginal with frequent bacteria violations and seasonally elevated turbidity and suspended sediment levels. However, the study focused on that portion of Lapwai Creek below Winchester Lake to the confluence with the Clearwater River, not the Winchester Lake watershed.

3) Idaho Department of Health and Welfare. Water Quality Status Report #61. Moeller (1986). Sampling was conducted by the Bureau of Water Quality in cooperation with the Idaho Department of Fish and Game over a 6-month period from May through October 1985. Measured parameters were selected to address the decline in water quality and fisheries.

Samples were collected every 2 weeks between May 7 and October 24, 1985, resulting in a total of 13 sample sets. Temperature, conductivity, and dissolved oxygen concentration profiles were determined at 1-m intervals from the surface to lake bottom on each sample date. Secchi disk transparency was measured in order to determine the euphotic zone, i.e. the area of effective light penetration, and the major region of primary production.

All water samples were immediately analyzed for pH. Water samples were analyzed for physical, chemical, and biological parameters at various frequencies within the general time frame of May through October. Euphotic zone samples were analyzed for chlorophyll *a*. Phytoplankton were collected 3 times: preceeding, during, and after the suspected period of maximum growth. Fish were collected with electroshocking methods on one occasion. Fish flesh from 2 species was analyzed for heavy metals and a wide spectrum of pesticides and herbicides. Sediments were collected every other month at the 6 sites with an Eckman dredge.

Moeller (1986) determined that Winchester Lake exhibited severe eutrophic symptoms. Anaerobic conditions and high temperatures were prevalent during summer. Secchi depths ranged from 0.4 to 1.5 m. Mean total phosphate concentrations in the euphotic zones were 6 times the recommended limits for reservoirs. The phosphorus loading rate of 1.1 $g/m^2/yr$ was 2.5 times the suggested critical rate of 0.45 $g/m^2/yr$ for eutrophic loading in lakes where the lake depth to hydraulic retention time ratio equals 5.0 m/yr (Vollenweider, 1973). The ratio of lake depth to hydraulic retention time in Winchester Lake is estimated to be 4.7 m/yr. Influent inorganic nitrogen concentrations were over twice critical values (0.3 mg/l). Mean chlorophyll *a* concentration was more than 6 times that considered eutrophic (10 ug/l).

Of the pesticides that were sampled, neither inorganic metals nor organic compounds (herbicides and pesticides) exceeded water quality criteria for fish flesh. However, values for DDT in one bullhead catfish indicate that DDT was present in 1984. Due to the small sample size of fish (n=4) and the unknown methods deployed for evaluating toxics, there was uncertainty as to whether pesticides are a problem in Winchester Lake. None of the toxics listed in Moeller (1986) are consistent with what is believed to be currently used by the agriculture industry on the upper Lapwai Creek watershed above Winchester Lake (see for example comparable chemicals listed as being used on the Big Canyon Creek Watershed in the Nez Perce Soil & Water Conservation District, 1995).

4) Lapwai/Mission Creek Status Report. No.65.Idaho Department of Health and Welfare, 1986. A study was done by IDHW-DOE in 1985 to determine baseline water quality and to document the effects of storm runoff on water quality in Mission/Lapwai Creeks. An estimated 53,000 lbs. of nitrite+nitrate as N and 6,000 lbs. of phosphorus were discharged from the Lapwai Creek drainage to the Clearwater River during storm events.

5) Phase I Diagnostic and Feasibility Analysis for Winchester Lake , Lewis County, Idaho. Entranco Engineers, Inc., 1990. Monthly samples were collected from a station in Winchester Lake from May 1988 to April 1989. Samples at this location were collected at 0.5 m below surface, mid-depth, and 0.5 m off the bottom. Parameters analyzed are: soluble reactive phosphorous (SRP), total phosphorous (TP), nitrite (NO_2), nitrate (NO_3), ammonia (NH_3), total Kjeldahl nitrogen (TKN), temperature, DO, pH, alkalinity, conductivity, secchi depth, turbidity, and chlorophyll-*a*. A total of 36 samples were collected.

Continuous flow recording (Stevens Gage) and sampling was conducted at the lake inlet and outlet on Lapwai Creek. Samples were also collected at 6 non-recording stations on Lapwai Creek upstream of Winchester Lake. A total of 126 samples were collected.

The 12-month lake study documented that water clarity at Winchester Lake was poor, generally restricted to 3 ft or less during summer months. Poor visibility is associated with the presence of visible blue-green algae blooms during the same period. About half the lake volume is unusable by trout between June and October due to a lack of dissolved oxygen. The study indicated that annual phosphorus loading to Winchester Lake is about 952 kg P/yr, and estimated that a load reduction of 534 kg P/yr would be needed to achieve an annual in-lake concentration (48 mg P/m^3) characteristic of the mesotrophic/eutrophic threshold. The study indicated about 71% of the phosphorus input to Winchester lake comes from external or watershed sources. The remainder is primarily released from sediments within the lake during anoxic conditions.

Bacteriological samples collected in Winchester Lake did not exceed State of Idaho criteria for primary contact recreation. However, the inlet to Winchester Lake did exceed the State of Idaho water quality standards for fecal coliform at least one time during the summer of 1988.

The study concluded that Winchester Lake was sufficiently degraded that an intensive and aggressive lake restoration and watershed management program was recommended.

6) Winchester Lake Fishery Monitoring Summary 1990,1991,1992. Idaho Department of Fish and Game, Lewiston , Idaho. The 1990 study concluded that growth rates of largemouth bass in Winchester Lake were the fastest of any largemouth bass populations in Clearwater Region lowland lakes. Larger bass forage on black bullheads and trout fingerlings. Spokane strain rainbow fingerlings (90 mm) stocked in May had all achieved 180 mm in size before fall gill net sampling.

The 1991 Fishery Monitoring Summary stated that Winchester Lake represented the most successful stocking program of the Clearwater Region lowland lakes.

The 1992 Fishery Monitoring Summary listed Winchester Lake as having the highest growth rates for trout of any Clearwater Region lowland lake.

7) Winchester Lake Restoration Project. Entranco Engineers, Inc., 1992. This document includes 3 separate reports pertaining to water quality management at Winchester Lake. This report reviewed and reevaluated water quality controls and phosphorus control strategies discussed in their 1990 report. It evaluated agricultural and riparian Best Managment Practices, compared the costs and benefits of dredging vs. aluminum sulfate (i.e. alum) treatment in the lake, and provided information on shoreline erosion control measures.

8) Mud Springs Reservoir: Phase I Diagnostic and Feasibility Water Quality Study. Nez Perce Tribe, Water Resources Division, 1995. This study included water quality monitoring of Mud Springs Reservoir, an 8.7 acre impoundment of Lapwai Creek above Winchester Lake. Algal blooms, low water clarity, low dissolved oxygen are symptomatic of eutrophic conditions; bacterial contamination potential was also identified by the study. Water quality was determined to be severely degraded and a restoration evaluation was conducted.

9) Clean Lakes Phase II Implementation and Restoration Project Report. Wertz, L., 1996. This report summarized the Winchester Lake Phase II Clean Lakes Project which included implementation of many of the components of the Lake Restoration Plan (Entranco, 1992). Water quality monitoring conducted from July 1992 through October 1995 showed mixed results with the lake meeting water quality goals during certain periods and not meeting them in others. Wertz speculated that this may be a product of Best Management Practice implementation or precipitation patterns.

10) DEQ monitoring, 1996. DEQ also collected water quality samples at Winchester Lake just prior to lake turnover during October, 1996. Data collected at 5 sites confirmed water quality concerns relative to dissolved oxygen and total phosphorous.

Summary of Existing Sediment Data

Wertz (1996) reports total suspended solids (TSS) data for upper Lapwai Creek from late-1993 to mid-1995. This data set represents the most comprehensive monitoring effort to date where continuous flow and composite TSS samples were taken using a Sigma sampler. Daily minimum, maximum and average flows were measured. Composite TSS samples were collected, producing an average weekly TSS concentration. Unfortunately, without knowing daily TSS concentrations, these TSS data have very limited application since TSS varies significantly with flow (Ketcheson, 1986).

Review of these assessments indicates the need to further quantify flow alteration and sediment loads. The following is a summary of problems identified that require further analysis.

- The Entranco (1990) water budget is only for water years 1988 and 1989. Additionally, new flow data exist (i.e., IDEQ, 1996) and need to be incorporated to estimate a long-term water budget for Winchester Lake.

- The sediment loads calculated by Entranco (1990) and IDEQ (1996) primarily account for suspended load. Like most systems in this region, bedload may represent a substantial portion of the total load (e.g., 5 to 20%). Additionally, the measured TSS concentrations are extremely low given the parent lithology (i.e., Palouse Loess). Commonly, TSS values in the Palouse exceed 100 to 2000 mg/l (Boucher, 1970). The median concentration measured in these assessments is 12 mg/l and the maximum is 200 mg/l.

- Entranco (1990) collected 15 TSS grab samples, which included only three storm events. Initial analysis of these data indicates no significant relationship between flow and TSS concentrations, meaning sediment load calculations might underestimate suspended load. A similar problem is present in the IDEQ (1996) data, where composite samples were collected using a Sigma Sampler. Less of a relationship exists in these data, meaning the majority of the load may not have been measured.

Water Quality Problem Summary

To summarize all the past water quality studies in Winchester Lake, the following water quality problems were identified: poor water clarity, nuisance algal blooms, low dissolved oxygen, high summertime temperatures, excess nutrients. The studies also indicated potential bacteria and pesticides contamination problems.

In 1994, Winchester Lake was listed by EPA as a water quality limited waterbody and Upper Lapwai Creek was listed as a water quality limited stream (US EPA, 1994). Section 303(d) of the Clean Water Act requires states to inventory all waters within their jurisdiction that exceed criteria for 1 or more parameters covered by state water quality standards. The 1994 303(d) list for the state of Idaho reports nutrients, sediment, dissolved oxygen, thermal modification, flow, habitat alteration, pathogens, and pesticides as pollutants of concern at Winchester Lake. This list reports nutrients, thermal modification, flow, habitat alteration, and pathogens as pollutants of concern for Upper Lapwai Creek.

Regarding flow limitations, there are no known irrigation diversions from Lapwai Creek above Winchester Lake. Thermal modification and habitat alteration concerns are likely related to the lack of shade in riparian areas along Lapwai Creek due to a combination of several cultural practices that denude and contribute to bank destabilization. One of the most obvious cultural practices is grazing in and along streams because few remedial Best Management Practices are currently in place. Nutrient and sediment problems have common sources. Dissolved oxygen problems likely result from excessive algal growth associated with the nutrient problem and the subsequent rise in biochemical oxygen demand (BOD) from organic decomposition.

Data Gaps

The assessments described above looked at water yield and sediment loads from Lapwai Creek and other minor tributaries to the reservoir. Review of these studies and available data indicates several substantial data gaps. The following is a list of identified data gaps:

- stream flow data, to characterize trends as well as peak flow conditions;
- more current and adequate suspended sediment data that characterizes trends as well as peak flow conditions;
- bedload data;
- assessment of the effectiveness of existing BMPs;
- more current water quality analyses for all pollutants of concern with pathogen data collection and analysis the most immediate priority;
- McNeil core samples and residual pool volume data in Upper Lapwai Creek;
- monitoring and/or modelling to assess the effect of reduced phosphorus loads and increased dissolved oxygen levels on water clarity and macrophytic plant growth;
- data to determine phosphorus loading attributable to background conditions;
- current data and analyses of the relationship between dissolved and particulate forms of phosphorus in Upper Lapwai Creek to help identify likely sources and background conditions;
- analysis of nutrient storage and release in Upper Lapwai Creek sediments; and
- dissolved oxygen trends in Upper Lapwai Creek.

2.3 POLLUTANT SOURCE INVENTORY

Pollutants and Sources

Parameters listed in Appendix "C" of the 1994 303(d) list for Winchester Lake are: nutrients; sediment; dissolved oxygen; thermal modification; pathogens; pesticides; flow and habitat alteration. Section 2.2 summarizes water quality monitoring results. Pollutants listed in this Appendix for Upper Lapwai Creek are: sediment; nutrients; thermal modification; pathogens; flow and habitat alteration.

Pollutant sources in the Winchester Lake watershed include: 1) agricultural and silvicultural runoff; 2) bank erosion due to grazing and other agricultural activities, silviculture, and recreation; 3) recreation; 4) atmospheric deposition (wind, rain or snow); and 5) storm water discharge. In addition to these external pollution sources, a release periodically occurs from nutrients that have accumulated in the lake bottom sediments.

Point Source Pollution

There are no point sources of pollution identified at Winchester Lake. Prior to 1972 the town of Winchester did not have a sewage collection system but discharged sewage to drainfields. The town now has a wastewater treatment facility that discharges treated effluent to Lapwai Creek 100 yards downstream from the lake outlet. In March of 1998, the city drained the sewage lagoon and pumped out all sludge to perform maintenance on the aerator system and to inspect the liner; the liner was in good condition so subsurface leakage from the lagoon should not be a source (M. Haight, 1998).

Nonpoint Source Pollution

Soils in the watershed are primarily of forest origin, derived from windblown silt (loess), decomposed granite and basalt. Soil types present are prone to erosion and sediment production if left unvegetated by conventional tillage, grazing or silvicultural activities.

Agricultural and silvicultural activities in the upper watershed degrade the water quality and beneficial uses of Lapwai Creek, the major tributary to Winchester Lake (Moeller, 1986). The primary pollutants entering the watershed tributaries and eventually Winchester Lake are excessive sediments and nutrients. The 1992 Entranco report estimated that 15 miles of critical stream bank reaches exist in the watershed, with 6.6 miles in the dryland agriculture area, 5.2 miles in rangeland, and 3.2 miles in forest lands. The report provides a map indicating the location of these critical stream bank reaches.

The large number of people fishing at Winchester Lake has resulted in large exposed shoreline areas. In 1992, Entranco inventoried the 7 miles of shoreline and classified areas into the following impact zones: high erosion (19%); low erosion (22%); potential future erosion (11%);

and minimal or no erosion (48%). These highly-impacted areas distracted from the beauty of the park and were a continual source of sediment and phosphorus to the lake. In 1990, Entranco identified direct runoff as contributing 54 kg P/year or 6% of the total phosphorus budget.

Septic Drain Fields

There are 2 septic drainfields in Winchester Lake State Park and an unknown number of individual drainfields dispersed throughout the watershed.

Urban Stormwater Runoff

Examination of topographic and land use maps indicates that approximately 70% of the town of Winchester drains toward Winchester Lake. There are several city streets that drain past the city sewage lagoon and into Winchester Lake.

2.4 POLLUTION CONTROL EFFORTS

Winchester Lake has been involved in the U.S. EPA Clean Lakes Program (Clean Water Act 314) since 1988. The Phase I Diagnostic and Feasibility Study was completed by Entranco Engineers in February 1990. The Phase I study also developed a lake restoration plan (Entranco, 1992) to address water quality problems. The restoration plan identified specific management activities to implement in the watershed with the goal of reducing sediment and nutrient loading to the lake. These management activities include agricultural, riparian, and forestry best management practices (BMPs) and direct runoff controls. If the water quality did not improve as a result of watershed loading reductions, the restoration plan suggested an aluminum sulfate treatment to reduce the contribution of phosphorus from lake bottom sediments.

The Winchester Lake Phase II Implementation and Restoration Project began in June 1990. The goals of this project were to:

1) implement the BMPs outlined in the lake restoration plan;
2) develop an information and education program; and
3) continue water quality monitoring to evaluate the effectiveness of BMPs.

Implementation and Restoration Activities

●Forestry BMPs--Timber harvest activities by private landowners occurred on approximately 850 acres in the watershed between January 1990 and June 1995. An estimated 8 miles of road were built as a result of this activity. The forestry BMPs were implemented under the Idaho Forest Practices Act and included proper road design and maintenance, stream protection zones, and replanting. The Nez Perce Tribe conducts Environmental Assessments (EA) on their timber lands before any harvest takes place. The implementation of the recommendations developed through EAs result in application of BMPs that are at least as stringent as those required under the Idaho Forest Practices Act. Clean Lakes Project money was not used to implement these BMPs.

●Direct Runoff BMPs--The large number of people fishing at Winchester Lake has created large exposed shoreline areas requiring erosion controls. The Winchester Lake State Park was responsible for implementing the shoreline erosion controls. The park reseeded areas that were the least damaged. On the areas that were severely damaged, the park constructed rock-filled baskets utilized as fishing platforms and additional docks for public access to the lake. Twenty rock-filled fishing platforms totaling 1100 linear ft were installed in the most damaged areas. The rock-filled baskets are not properly constructed gabions and currently require repair. Five docks were constructed into a T-shape design providing 32 linear ft of fishing area for every 8 ft of shoreline used. The public response to these improvements has been very positive. Implementation of these BMPs cost approximately $26,825. Estimated cost to repair the rock-filled fishing platforms is $2500 each or $50,000 (Silvers, 1998).

●Agricultural BMPs--The Lewis Soil Conservation District was contracted by the Idaho Division of Environmental Quality to administer the installation of the nutrient and sediment control structures within the Winchester Lake watershed. Since 1990, within the Winchester Lake watershed, 11 contracts treating 2880 cropland and pastureland critical acres have been initiated (ongoing projects). Conservation tillage is the most common treatment practice. The Clean Lakes project funded the installation of sediment basins and gully plugs on acres through District contracts with landowners. As of January 1998, 7 sediment basins, 20 gully plugs, and 7 grade stabilizations had been constructed. The District had $68,000 to implement these structural BMPs and as of January 1998, $7,000 is unspent but obligated for BMP installation. A complete list of BMPs installed is shown in Table 4. Locations are shown in Figure 9.

●Riparian BMPs--The Lewis Soil Conservation District administered the installation of the riparian BMPs. Due to limited funding that did not allow for treatment of all the high priority areas, the District chose to develop a riparian demonstration area. The demonstration area is located in the upper portion of the watershed above Mud Springs Reservoir and is used to educate landowners in the watershed about riparian BMPs. This area had extensive bank erosion and little woody vegetation. Seven log drop structures were constructed in 900 feet of the stream. These structures are designed to raise the water table near the stream so that vegetation can be reestablished. Additionally, 2800 ft of fencing and a livestock access ramp were installed so that the cattle could only cross the creek in one location. A livestock water supply was built away from the creek to give the cattle an alternate water supply. In the spring of 1995, the District and the Nez Perce Tribe planted several hundred willow cuttings along the creek in an effort to restore the riparian area. The District spent $6,000 to implement the riparian BMPs. In addition, 4021 feet of fence have been built and a rotational grazing plan has been implemented on a landowner's property along Lapwai Creek between Winchester Lake and Mud Springs reservoir. In addition, 2 log drop structures and 4 spring developments are planned for implementation on the same property.

The Nez Perce Tribe has worked to restore Lapwai Creek above and below Mud Springs Reservoir within the Nez Perce Reservation. The upper stream was fenced off, willows were planted, and transects were established to evaluate aggradation and degradation. The reservoir was deepened by the Nez Perce Tribe in the fall of 1998 and will be restocked with trout and bass.

Information and Education

The information and education component of the Phase II project consisted of several different activities designed to increase awareness of the lake's condition and the efforts needed to restore the lake's water quality. In the summer of 1994, approximately 300 people at Winchester Lake State Park participated in a survey that determined the demography of the park and lake users, the activities they participated in while at the park, their preferred fishing locations, their views on water quality, and their knowledge of BMPs. After the survey the participants were given information regarding the lake project and the BMPs in the watershed.

Table 4. Summary of BMPs (Lewis Soil Conservation District).

Winchester Lake Clean Lakes Project Summary of BMPs Installed (as of 1/26/98)			
NUMBER INSTALLED	**BMP**	**AMOUNT SPENT**	**COST PER UNIT**
7 ea	Sediment basins	$3,598.50	$514.07/unit
20 ea	Gully plugs	$7,674.00	$383.70/unit
7 ea	Grade stabilization structures	$4,048.00	$578.29/unit
36 ea	Standpipes	$3,361.00	$93.36/unit
18,012 ft	4" underground outlet	$14,221.00	$0.79/ft
12,593 ft	6" underground outlet	$19,128.00	$1.52/ft
6 ea	Log drop stabilization structure	$2,339.00	$389.83/unit
1 ea	Livestock access ramp	$390.00	$390.00/unit
419 rods or 6915 ft	Fence	$5,825.00	$13.90/rod $0.84/ft
TOTAL AMOUNT SPENT FOR BMP=S = $60,584.50			

PRACTICES INSTALLED ON PRIVATELY OWNED PROPERTY THROUGH OTHER PROGRAMS	
Lapwai State Ag Water Quality Project	11 contracts providing financial incentives installing ag-related BMP's on 2880 privately-owned critical acres.
Public Law 566	3 basins Contract signed with Nez Perce Tribe on Mud Springs
Annual Conservation Practices	Spring developments
Idaho Department of Lands	Timber management/ thinning/ reforestation
Privately-installed	2 additional log drop structures

1996 PHASE II REPORT LISTS 5 JURISDICTIONAL ENTITIES ABOVE THE LAKE
IDFG ● IDPR ● Lewis County ● City of Winchester ● Nez Perce Tribe

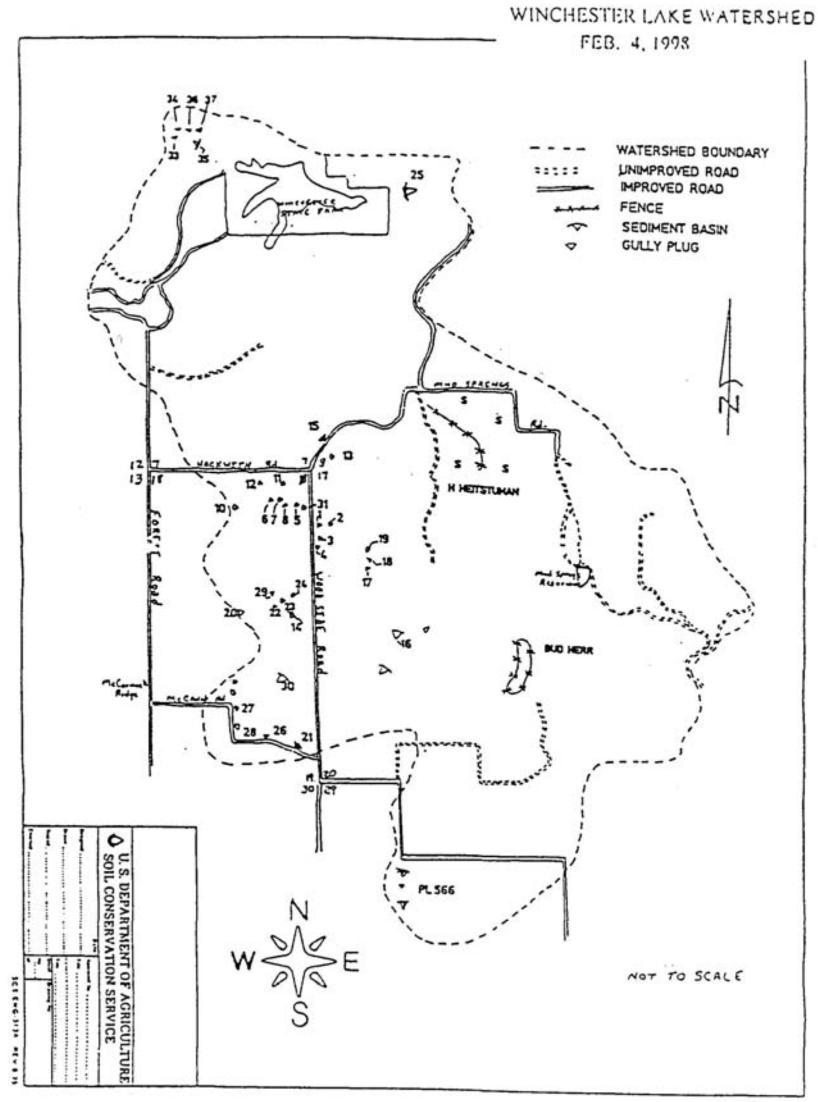


Figure 9. Improvement Location Map

Two brochures were developed for the project and distributed to the public. The first brochure described the Clean Lakes Project, water quality in the lake, watershed sources of pollution, and the lake management plan. The second brochure was targeted at landowners in the watershed and explained various types of recommended BMPs. Informational display boards were constructed. The displays contained 3 informational panels about the lake project. These panels were displayed at several locations within the park, placed at the Lewis Soil Conservation District Office and used by DEQ when addressing various groups. A traveling display was developed and used for an exhibit at the Lewis County Fair and other locations.

Mechanisms for Implementation of Nonpoint Source Reductions

Nonpoint source reductions listed in the Winchester Lake TMDL will be achieved through the combination of authorities the state possesses within the Idaho Nonpoint Source Management Program, Nez Perce Tribal authorities, and commitments the community makes in the future Winchester Lake Watershed Implementation Plan. Section 319 of the Federal Clean Water Act requires each state to submit to EPA a management plan for controlling pollution from nonpoint sources to waters of the state. The plan must do the following: identify programs to achieve implementation of the best management practices (BMPs), outline a schedule containing annual milestones for utilization of the program implementation methods and for implementation of best management practices, obtain certification by the attorney general of the state which states that adequate authorities exist to implement the plan, and provide a listing of available funding sources for these programs.

Existing authorities and programs for assuring implementation of BMPs to control nonpoint sources of pollution in Idaho include:

- State Agricultural Water Quality Program
- Wetlands Reserve Program
- Environmental Quality Improvement Program
- Idaho Forest Practices Act
- Water Quality Certification For Dredge and Fill
- Stewardship Incentive Program
- Wildlife Habitat Incentive Program
- Nonpoint Source 319 Grant Program
- Conservation Reserve Program
- Resource Conservation and Development
- Agricultural Pollution Abatement Plan
- Stream Channel Protection Act
- Forestry Incentive Program
- Environmental Quality Incentive Program

The Winchester Lake Restoration Plan pre-dates the Winchester Lake and Upper Lapwai Creek TMDL and was conceived and developed as the most appropriate plan for community-implemented nonpoint source water quality pollution controls. The Plan lists activities that can be implemented by the community to enhance water quality in the entire Winchester Lake watershed. The Plan includes costs and a schedule for implementation of each activity. Activities include but are not limited to: riparian tree plantings; agricultural best management practices; bioengineering structures; and education and information programs to increase community awareness of the water quality conditions and the activities to be undertaken to restore water quality in the Winchester Lake watershed.